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TECHNICAL MEMORANDUM

Treatability Studies

Waukegan Manufactured Gas and Coke Plant Site

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TREATABILITY STUDY TECHNICAL MEMORANDUM

WAUKEGAN MANUFACTURED GAS AND COKE PLANT SITE

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TREATABILITY STUDY TECHNICAL MEMORANDUM

WAUKEGAN MANUFACTURED GAS AND COKE PLANT SITE

SECTION 1: INTRODUCTION

This technical memorandum has been prepared to fulfill the treatability study project planning activity for the Remedial Investigation and Feasibility Study (RI/FS) at the Waukegan Manufactured Gas and Coke Plant (WCP) site. The purpose of this memorandum is to examine the treatability testing needs of the remedial action technologies identified in the RI/FS Work Plan so that, if treatability testing is required, it can be performed in a timely manner to minimize delays in the preparation of the FS. For each of the remedial action objectives that involve a treatment component, the available information from the literature has been assessed to determine whether existing information is sufficient for evaluation (and selection or rejection) of the remedial technology. This memorandum discusses candidate technologies for treatability studies, evaluates the available literature, and identifies factors that influence the need for additional studies.

Treatability studies serve two primary purposes: 1) to aid in the selection of the remedy; and 2) to aid in the implementation of the selected remedy. Treatability studies conducted during the RI/FS process are intended to determine whether a remedial technology can meet the site-specific remedial action objectives for the site (USEPA, 1989) and are consistent with the goals of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Section 121(b) of CERCLA requires the United States Environmental Protection Agency (USEPA) to select, where appropriate, remedial actions involving treatment that "permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants."

Treatability studies are used to fill in information gaps in the available technical literature for remedial alternatives and to assess the effect of site-specific and waste-specific factors on the performance of remedial alternatives. They involve laboratory or field testing in order to assess their performance on specific wastes on a site (USEPA, 1989). According to the RI/FS interim guidance document (USEPA, 1988), a treatability study can assess seven of the nine listed evaluation criteria for the selection and analysis of treatment alternatives. These include:

1) Overall protection of human health and the environment
2) Compliance with applicable or relevant and appropriate requirements (ARARs)
3) Implementability
4) Reduction of toxicity, mobility, or volume
5) Short-term effectiveness
6) Cost
7) Long-term effectiveness

The remaining criteria, community and state acceptance, can play a decisive role in the decision to conduct treatability studies for a particular remedial technology (USEPA, 1989). If the existing literature on a given remedial technology and data obtained during the remedial investigation are sufficient to address the nine listed evaluation criteria, a treatability study would not be needed.

It is not appropriate at this point to make a decision to perform treatability studies. The decision to conduct a treatability study should be made based on an evaluation of the site and waste characteristics and the site-specific remedial action objectives. Additional site and waste characterization data collected during the RI are necessary to effectively screen and evaluate the remedial action technologies and to design a meaningful treatability testing program, if required. The remedial action objectives may also be refined based on the site and waste characterization and can also strongly influence the screening of technologies and the design of a treatability testing program.

After the Phase I investigation, the potential need for treatability studies will be reassessed. If candidate technologies are identified which appear likely to be cost effective and appropriate to the site, and the technology has not been sufficiently demonstrated or cannot be adequately evaluated, then additional site-specific technology evaluations or treatability studies will be proposed.

Section 2 of this memorandum gives a brief description of the site and the history of industrial operations at the site. Section 3 provides a preliminary identification of the contaminants present or expected to be present at the site based on previous investigations at the site and data from similar sites. Section 4 of this report focuses on remedial action technologies for contaminated soils, and Section 5 focuses on technologies for contaminated groundwater. Both Sections 4 and 5 present brief technology descriptions, followed by summaries of information from the literature on previous applications and performance of the technologies at coal tar or related sites, and discussions of whether treatability studies are needed to evaluate and select the applicable remediation technologies. Section 6 provides a summary of the remedial action technologies that are candidates for treatability studies and the process for deciding to perform a treatability study.

SECTION 2: BACKGROUND

The following section summarizes the background site information contained in the RI/FS Work Plan (Barr, 1991). For further information, refer to the RI/FS Work Plan which provides greater detail on site history, operations, and environmental investigations based on a review of available information.

The WCP site is located in the City of Waukegan, Illinois. The site is on a peninsula on the east side of Waukegan Harbor, bounded on the north and east by Pershing Road (Sea Horse Drive), on the south by OMC Plant No. 1, and on the west by Waukegan Harbor.

A number of different industrial operations have been conducted at the site beginning with a wood treating plant which was in operation between approximately 1908 and 1912. In the late 1920's, a coke oven gas plant was constructed at the site by the William A. Baehr Organization. The facility was sold to the North Shore Coke and Chemical Company which operated the plant and sold the excess gas production to North Shore Gas Company. In 1947, General Motors purchased the facility and used it until 1971 to supply coke for foundry operations in Michigan. Outboard Marine Corporation (OMC) purchased the facility in 1971 and subsequently dismantled the plant and used the property for a variety of operations.

SECTION 3: POTENTIAL CONTAMINANTS OF CONCERN

Coal gasification and coking processes may have resulted in the release of coal tars and sludges to the environment at the site. Coal tar is only slightly soluble in water and may be present in a distinct non-aqueous phase. Coal tar is more dense than water and may migrate under the influence of gravity. Downward migration may be limited by contact with a low permeable material. Lateral migration is dependent on the slope of the contact surface with the low permeable material.

Railroad tie processing operations may have resulted in the release of creosote to the site. Creosote is chemically similar to coal tar, being produced by the blending of fractional distillates of coal tar.

The composition of creosote and coal tars and sludges consists of hundreds of different compounds, including polynuclear aromatic hydrocarbons (PAHs), phenols, and volatile aromatics. PAH compounds are relatively immobile compounds that have a strong tendency to adsorb to soils. PAHs are biodegradable with the highest degradation rates for the lower molecular weight compounds. The volatile aromatic compounds generally associated with coal tars include benzene, ethyl benzene, toluene, and xylenes. These compounds are relatively mobile in the environment and are readily biodegradable under suitable conditions. Several inorganic and metal compounds that may be found in by-products and wastes associated with coking and manufactured gas operations may also be of concern. Table 1 lists the potential chemicals of concern related to manufactured gas and wood treating operations, including chemicals associated with the purification processes, coal ash, and coal tar.

Polychlorinated biphenyls (PCBs) are also of concern since the western boundary of the site borders the Outboard Motor Corp./Waukegan Harbor Superfund site where PCBs are the primary contaminant. PCBs are synthetic aromatic organic chemicals that are persistent in the environment and have a strong tendency to adsorb to soils and sediments.

Recent site construction activities have been related to the Outboard Marine Corp./Waukegan Harbor superfund project. As part of that project, a new boat slip has been constructed on the northwest part of the site and designated contaminated soil excavated during construction has been placed in an on-site containment cell (Canonie Environmental, 1990).

A soil investigation conducted prior to construction of the new slip identified oily soils containing PAHs and phenolic compounds. Contamination in the area of the new slip was identified at depths up to 25 feet below the ground surface. The Illinois Environmental Protection Agency has also analyzed ten soil samples collected from various locations. The laboratory analysis of these samples indicated the presence of PAHs, phenolic compounds, inorganic compounds and volatile aromatic compounds.

SECTION 4: REMEDIAL ACTION TECHNOLOGIES FOR SOILS AND SLUDGES

For evaluation purposes, the remedial technologies have been divided into soil and groundwater technologies. It is recognized that many of the groundwater remedial technologies are interrelated, with soil remediation technologies having positive impacts on the groundwater quality, and vice versa. Based on a preliminary understanding of the contaminants present at the site, the following list of potentially applicable soil remedial action alternatives was presented in the RI/FS Work Plan:

- No Action
- Monitoring and Institutional Controls
- Containment
- Biological Treatment
- In Situ Soil Flushing
- In Situ Stabilization/Solidification
- In Situ Vitrification
- In Situ Vapor Extraction
- Excavation
- On-Site Vault
- Off-Site Disposal
- Thermal Treatment
- Soil Washing

Remedial alternatives that do not involve a treatment component were eliminated from further review in this memorandum because they would not require a treatability study. The following remedial alternatives for soil that do not involve a treatment component and are not discussed further: No action, monitoring and institutional controls, containment, excavation, on-site vault, and off-site disposal. The soil remedial action technologies with a treatment component will receive further review as potential candidates for treatability studies. The next paragraphs provide brief descriptions of the soil treatment technologies, followed by a summary of information from the literature on previous applications and performance of the technologies at coal tar or related sites, and a discussion of whether treatability studies are needed to evaluate and select the applicable remediation technologies.

4.1 Biological Treatment

4.1.1 Description

Biological treatment involves providing conditions, either in situ or above ground, which are suitable for the growth and metabolism of microbial organisms capable of transforming contaminants into non-hazardous compounds. In situ biological treatment is performed by providing nutrients and an electron donor (usually oxygen) to the contaminated zone and ensuring that the microbial population and soil environment are satisfactory for biodegradation of the target compounds. Nutrients are usually added as aqueous solutions through infiltration trenches or injection wells. Oxygen may be added in an aqueous solution in the form of dissolved oxygen or peroxide or by air injection.

Land treatment is an above ground treatment method for biological treatment of excavated soils. Land treatment involves maintaining soil aeration and mixing by tillage as well as proper nutrient, pH, and moisture conditions for the degradation of the target compounds. Land treatment of contaminated soils may be subject to regulatory restrictions pertaining to land disposal.

Another form of biological treatment, composting, is in many ways similar to land treatment, but can be performed in a much more controlled setting. Therefore, meeting regulatory requirements to secure a permit for composting may be easier than for land treatment.

Compounds typically found at former MGP sites that are readily biodegradable include VOCs, phenolics and low molecular weight PAHs. PAH compounds with four or more rings are less readily biodegraded because of their low aqueous solubility. Generally, bioremediation is most effective for soils with less than 10,000 mg/kg of total PAHs. Soils with higher concentrations of PAHs may be treated more cost-effectively by other methods which may be followed by bioremediation to reduce the residual PAH concentration.

4.1.2 Previous Applications

The use of bioremediation at manufactured gas sites is relatively new and not well documented in the literature. Most bioremediation projects at manufactured gas sites are in the feasibility or treatability study stage, though several vendors report successful full-scale implementation of bioremediation at manufactured gas plants in Europe (Balba, 1991; Bioremediation Service, 1990). Land treatment of oily, PAH contaminated soils resulting from petroleum transportation and refining, wood treating and other sources has been well documented (Sims et al., 1986). Above ground treatment of coal tar contaminated soil has been demonstrated in the field at pilot scale (Taddeo et al, 1989). Additionally, numerous laboratory and field tests have been performed to assess the degradation rates and factors influencing the degradation of PAH compounds in soils (Park et al., 1990). Previous in situ bioremediation projects have generally involved contamination with more readily degraded, lower molecular weight compounds though there are no apparent barriers to the in situ biological treatment of PAH compounds as well.

4.1.3 Need for Treatability Studies

Several factors need to be considered to evaluate the potential for bioremediation. Soil and groundwater characteristics to be determined during the remedial investigation will provide information on the potential for inhibition of microbial growth due to extremes in pH, heavy metals, and organic concentrations.

Several additional site characteristics affect the feasibility of in situ bioremediation. The suitability of the soil environment for microbial degradation needs to be assessed. Specifically, the potential for oxygen and nutrient delivery, existing microbial population, and bioavailability of the contaminant should be analyzed. In situ bioremediation is usually most successful in coarser grained soils (Retech, 1989) and often limited by the ability to supply an electron donor and nutrients throughout the contaminated zone. Thus, the characterization of the site hydrogeology during the RI will provide essential information for the evaluation of in situ bioremediation.

The biodegradability of most organic compounds expected to be present at the site is well documented. Further study to screen for biodegradability may be needed if the RI results indicate the potential for microbial inhibition.

4.2 In Situ Soil Flushing

4.2.1 Description

In situ soil flushing involves using a liquid medium as a washing solution to extract contaminants from soils. The process consists of a groundwater extraction/reinjection system where water (with or without chemical addition to improve the leaching of contaminants) is injected to increase the contaminant solubility. Chemicals that are added to decrease the interfacial tension between the water and organic contaminants include acids, alkalis, surfactants, and organic polymers. The contaminated groundwater from the extraction wells is treated and reinjected into the system creating a closed loop system. This treatment process has the greatest potential for success with contaminated soils with limited number of specific chemicals.

4.2.2 Previous Applications

In situ soil flushing has been used in conjunction with soil washing on a site contaminated with creosote and metallic salts (Ref. ?)

4.2.3 Need for Treatability Studies

The preliminary screening of this remedial alternative can be made based the results of the RI site and waste characterization and on cost and performance information obtained from vendors, databases, and the literature. Important soil parameters to be determined during the RI (including soil classification, properties, particle size distribution, total organic carbon, and constituent concentrations) will aid in the evaluation of in situ soil flushing. Because this technology is highly site- and chemical-specific, additional testing would likely be required if this alternative were selected for detailed analysis. Such testing would determine partitioning coefficients for constituents, treatment efficiency, and toxicity of the washing fluid. As with in situ bioremediation, in situ flushing is dependent on the capability to move a treatment solution through the contaminated zone. The capability is strongly influenced by the site soils and hydrogeology.

4.3 Stabilization/Solidification

4.3.1 Description of Stabilization/Solidification

Stabilization/solidification is used to reduce the mobility of contaminants. This treatment technology can be performed in situ or above ground on excavated soils. The following mechanisms are used in this treatment technology: (1) encapsulation within a low permeability material; (2) chemically binding the contaminant with a nonhazardous fixation material; and (3) chemically altering the material so that it becomes more inert or binds to the fixation material. The binding mechanism is classified by the stabilizing agents used which include cement based, pozzolanic or silicate based, thermoplastic based, or organic polymer-based. Solidification/stabilization techniques typically use common construction machinery to mix the wastes and reagents.

4.3.2 Previous Applications

Stabilization/solidification techniques have been used extensively for a variety of inorganic wastes including incinerator ash with high metal concentrations and radioactive wastes. This treatment technology can also be applied to sludges and soils which contain non-volatile organics such as PCBs and PAHs. Stabilization/solidification techniques have been applied to RCRA and CERCLA wastes prior to landfilling (USEPA, 1988). Finally, bench scale studies have been performed on coal gasification wastes which show reductions in the leachability of metals and volatile organics.

4.3.3 Need for Treatability Studies

To evaluate the possibility of using stabilization/solidification techniques, several soil parameters will be determined in the RI including soil classification, properties, particle size distribution, porosity, specific gravity, and constituent concentrations. However, because this technology is highly site- and chemical-specific, additional testing would likely be required if this alternative were selected for detailed analysis. Many vendors will perform such testing on small waste samples.

4.4 In Situ Vitrification

4.4.1 Description of In Situ Vitrification

In situ vitrification is the electrical melting of soils at high temperatures to provide pyrolytic destruction of organic contaminants and immobilization or inorganics within the vitrified mass. Due to the shallow groundwater table at the site, in situ vitrification is likely infeasible because the groundwater will be the primary conductor of the electric current that passes through the soil instead of the contaminated soil.

4.5 In Situ Vapor Extraction

4.5.1 Description of In Situ Vapor Extraction

In situ vapor extraction is the removal of volatile compounds from soil in the gas phase using a system of wells screened in the vadose zone, vacuum pumps, and possibly an air treatment system.

4.5.2 Previous Applications

In situ vapor extraction is only applicable for volatile contaminants with vapor pressures above a minimum of 0.1 mm Hg. Thus, in situ vapor extraction would only be applicable to aromatic compounds, and possibly the two ring PAH compounds, and would be ineffective for the higher molecular weight PAHs that are likely the predominant contaminants at this site.

4.5.3 Need for Treatability Studies

Unless a significant zone of contamination with volatile compounds is encountered, this technology will be eliminated in the screening of technologies. In situ vapor extraction technology is well documented in the literature so that if the site characterization results revealed that it was potentially applicable, the selection or elimination of this technology could be made without a treatability study. The technology can be adequately evaluated using a conceptual design based on typical parameter values. If this alternative is selected, the actual implementation would likely involve either pilot testing or a phased installation.

4.6 <u>High Temperature Thermal Treatment (Incineration)</u>

4.6.1 Description

The high temperatures used in high temperature thermal treatment provide virtually complete destruction of organic contaminants. There are several types of thermal treatment facilities that can be used for the treatment of manufactured gas plant (MGP) site wastes, primarily incinerators. These facilities include fluidized bed incineration, rotary kiln incineration, infrared thermal treatment, and pyrolytic incineration. A pyrolytic incineration process referred to as the Taciuk process will receive special attention because a mobile unit is to be used at the adjacent Outboard Marine Corporation/Waukegan Harbor Superfund site.

4.6.2 Previous Applications

Several industries have utilized their own incineration facilities to dispose of contaminated tars and soils from their facilities. Utility companies have treated coal tar wastes by blending with coal and feeding to an industrial boiler. As of 1987, Allied Chemical has two boilers in operation designed to handle high heat content wastes. The materials are required to have a gross heating value of at least 8000 Btu/lb and need to be free of chlorinated compounds (GRI, 1989). The use of these facilities for the disposal of MGP site wastes may be limited in the future if some MGP wastes are classified as RCRA hazardous wastes.

MGP wastes have been used as an alternative fuel source at cement kilns. Generally, the materials that are used must be in a liquid form. Typical characteristics of acceptable material are a heat content between 8,000 and 10,000 Btu/lb, viscosity of 100 to 200 cp, chloride content between 3 and 5 percent, ash content between 7 and 70 percent, metals concentration (lead, barium, zinc, and chromium) of 4000 to 6000 ppm each, and a separated water content of 1 to 2 percent (GRI, 1989).

Other fuel production technologies which have utilized MGP site wastes include blending with other materials to improve their heating value and/or material handling characteristics. Specific technology applications include the AKJ process, Kipin process, and Dust Coatings. The AKJ process converts coal tar materials to a liquid fuel similar to that of No. 6 fuel oil while the Kipin process blends coal tar materials with coal fines. Finally, the Dust Coatings process is a less complicated version of the Kipin process.

Testing has shown that the Taciuk process provides effective hydrocarbon removal from soils. Virtually all of the organic material was removed from a blend of oil refinery wastes. The highest removal efficiencies (in excess of 99 percent) were for the volatile organic compounds (API, 1987).

4.6.3 Need for Treatability Studies

Several waste characteristics will be determined during the RI to assess the possibility of incinerating MGP wastes. These parameters include gross heating value, which determines whether the waste qualifies for supplemental fuel usage, and soil particle size distribution. Other parameters to be determined during the RI that are relevant to thermal treatment include total organic carbon content, metals concentrations, and organic constituent concentrations (USEPA, 1988). Because high temperature thermal treatment has been widely applied to similar wastes and is not as waste-specific as other alternatives, a treatability study would not be required to screen this technology. During the detailed analysis of high temperature thermal treatment, additional relevant analytical parameters could be easily determined to allow more accurate cost estimating. Such parameters might include ash content and chloride concentration. Some newly emerging high temperature thermal processes may be less proven and require further testing if selected for detailed analysis.

4.7 Soil Washing

4.7.1 Description of Soil Washing

Soil washing, like in situ soil flushing, uses a liquid medium as a washing solution to extract contaminants from soils. Soil washing is used for excavated contaminated soils. An example of a soil washing system with water as the washing solution consists of a coarse screen to filter out the larger nonsoil materials and debris (USEPA, 1988). The remaining waste then passes through a soil scrubber where it is sprayed with the washing solution. Soil particles larger than 2 mm are sorted out, rinsed, and dewatered. The remaining soil is treated by passing the waste countercurrent to the washing solution. The contaminated washing solution is then treated using conventional wastewater treatment processes and recycled. Some soil washing systems use other remedial technologies such as incineration or biological treatment to handle the contaminated residual soils.

4.7.2 Previous Applications

Soil washing techniques have been used at former oil refineries, manufactured gas plants, and oily wastes. In an experiment performed in West Germany, soil washing using high pressure water injection and a pump-out system reduced the PAH soil contamination from 20,000 mg/kg to 10 mg/kg. Experimental work has also been performed on contaminated soils from a manufactured gas plant through the use of drum which is filled with contaminated soil and coal suspended in water. The drum is tumbled at an elevated water temperature with the clean soils eventually separated from the coal (TBSG, 1989). Furthermore, soil washing and in situ soil flushing has been used on a site contaminated with creosote and metallic salts (Ref. ?)

4.7.3 Need for Treatability Studies

The preliminary screening of this remedial alternative can be made based the results of the RI site and waste characterization and on cost and performance information obtained from vendors, databases, and the literature. Important soil parameters to be determined during the RI (including soil classification, properties, particle size distribution, total organic carbon, and constituent concentrations) will aid in the evaluation of in situ soil flushing. However, because this technology is highly site- and chemical-specific, additional testing would likely be required as part of a detailed analysis of in situ soil flushing. Such testing would determine partitioning coefficients for constituents, treatment efficiency, and toxicity of the washing fluid.

SECTION 5: REMEDIAL ACTION TECHNOLOGIES FOR GROUNDWATER

The following list of groundwater remediation alternatives was presented in the RI/FS Work Plan:

- No Action
- Monitoring and Institutional Controls
- Containment
- In Situ Biological Treatment
- Groundwater Extraction
- Groundwater Treatment and Discharge

No action, monitoring and institutional controls, containment, and groundwater extraction are not treatment technologies and will not require treatability studies. In situ biological treatment is one alternative that involves the remediation of both the contaminated soils and groundwater and was discussed in Section 4.2.

The groundwater treatment and discharge alternative potentially involves use of several different treatment alternatives. Treatment alternatives for the extracted groundwater include packed tower aeration, activated carbon adsorption, enhanced oxidation, and biological treatment.

5.1 Packed Tower Aeration

5.1.1 Description

Packed tower aeration, or air stripping, is the transfer of volatile contaminants from the extracted groundwater to the air phase. A packed tower uses a countercurrent flow of water and air to exchange volatile contaminants from the aqueous to the gas phase.

5.1.2 Previous Applications

Packed tower aeration technology has seen widespread application for both drinking water treatment and groundwater remediation. The technology is limited by the air-to-water partition coefficient for the compound of concern. Most of the contaminants present at the site are expected to be higher molecular weight PAH compounds associated with coal tars and are not amenable to this technology.

5.1.3 Need for Treatability Studies

Because packed tower aeration is a standard mass transfer process that has been widely applied to environmental remediation, typical sizing guidelines, cost information, design equations and models are readily available. The values for chemical properties that are input parameters for the design equations and models are also generally available in the literature or can be estimated with standard procedures. For this reason, it is unlikely that a treatability study for packed tower aeration will be required.

5.2 Activated Carbon Adsorption

5.2.1 Description

Activated carbon adsorption is the transfer of contaminants from the extracted groundwater to an adsorbed phase on the surface of the activated carbon particle.

5.2.2 Previous Applications

Activated carbon adsorption has seen widespread application for both drinking water treatment and groundwater remediation. The technology is limited by the absorbability of the compound to be treated. The contaminants present at the site that are associated with coal tars or creosote are readily adsorbed onto activated carbon and are considered amenable to this technology.

5.2.3 Need for Treatability Studies

Because activated carbon adsorption is a standard engineering mass transfer process that has been widely applied to environmental remediation, typical sizing guidelines, cost information, and design models for single component and multi-component adsorption are readily available. Activated carbon adsorption isotherm data is generally available in the literature for the contaminants of concern. For these reasons, a treatability study for activated carbon adsorption does not appear warranted for technology screening purposes. A bench-scale dynamic column test may provide useful information on actual carbon burn rates and could be conducted during the detailed analysis or remedial design stages.

5.3 Enhanced Oxidation

5.3.1 Description

Enhanced oxidation uses a mixture of oxidizing agents to destroy groundwater contaminants. The most commonly used oxidants are ozone, hydrogen peroxide, and ultraviolet (UV) radiation. The increased oxidation rates are the result of the action of the powerful oxidizing radicals such as the hydroxyl radical ($HO\bullet$) and the perhydroxyl radical ($HO_2\bullet$). Some organic contaminants have low reaction rates with the hydroxyl radicals and are therefore less amenable to enhanced oxidation treatment.

5.3.2 Previous Applications

Enhanced oxidation systems have received attention recently and have been demonstrated in the field for treatment of volatile organic compounds (USEPA, 1990) and PAH compounds (Smith, 1990).

5.3.3 Need for Treatability Studies

Performance data and cost information is available for enhanced oxidation systems so that a treatability study would not be required to screen this technology. If this alternative were selected for detailed analysis, a relatively quick treatability test could be performed to confirm the treatment effectiveness.

5.4 Biological Treatment

5.4.1 Description

This alternative involves an above-ground biological reactor and ancillary equipment such as nutrient addition, aeration, and clarification equipment. The biological reactor would likely be a fixed film reactor for process reliability and ease of operation and could be operated aerobically or anaerobically. The organic compounds expected to be present at the site are generally biodegradable.

A variation of the biological treatment alternative is to use biodegradation in conjunction with activated carbon adsorption. Activated carbon can be used as the fixed-film media or can be suspended in a slurry reactor. Biodegradation, in such a system, would work to regenerate the activated carbon. An additional form of biological treatment would be to discharge the groundwater to the Publicly Owned Treatment Works (POTW). A discharge to the POTW would likely require demonstration of no adverse effects on the POTW treatment system performance and effluent quality.

5.4.2 Previous Applications

Aerobic biological treatment has been demonstrated for water containing PAH compounds. Anaerobic biological treatment in conjunction with activated carbon has been shown effective for wastewaters containing phenols and polycyclic-N-aromatic hydrocarbons from coal gasification plants (Fox et al., 1988). Pilot-scale work has shown that co-treatment of manufactured gas plant site waters with municipal wastewaters resulted in no measurable effects on performance or discharge quality (Smith and Weightman, 1988).

5.4.3 Need for Treatability Studies

A treatability study should not be required for biological treatment of pumped groundwater. If this alternative were selected for detailed analysis, additional testing may be warranted at that point.

SECTION 6: SUMMARY

The potential remedial action technologies for soil and groundwater at the WCP Site were evaluated to assess the need for treatability studies to effectively screen and select the appropriate remedies for the site. Without site characterization data that will be obtained during the RI, and without specific remedial action goals, it is not appropriate at this time to make a final determination as to which treatability studies, if any, to perform. Based on a review of the literature, it appears the remedial alternatives for contaminated soil and groundwater can be adequately screened without treatability studies.

The following soil remedial action technologies are potential candidates for further testing (e.g., bench-scale testing or pilot tests) if they are retained after the preliminary screening for detailed analysis: biological treatment, in situ soil flushing, stabilization/solidification and soil washing.

Because most of the groundwater remedial action technologies are widely used, none requires a treatability study for preliminary screening. Only enhanced oxidation and biological treatment may require further testing if they pass the preliminary screening and are retained for detailed analysis.

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TABLE 1

POTENTIAL CHEMICALS OF CONCERN
MANUFACTURED GAS PLANT SITES

Purification Process	Coal Ash	Coal Tar		
INORGANICS	METALS	VOLATILE AROMATICS	PHENOLICS	POLYNUCLEAR AROMATIC HYDROCARBONS
Ammonia	Aluminum	Benzene	Phenol	Acenaphthene
Cyanide	Antimony	Ethyl Benzene	2-Methylphenol	Acenaphthylene
Nitrate	Arsenic	Toluene	4-Methylphenol	Anthracene
Sulfate	Barium	Total Xylene	2,4-Dimethylphenol	Benzo(a)anthracene
Sulfide	Cadmium			Benzo(a)pyrene
Thiocyanates	Chromium			Benzo(b)fluoranthene
	Copper			Benzo(g,h,i)perylene
	Iron			Benzo(k)fluoranthene
	Lead			Chrysene
	Manganese			Dibenzo(a,h)anthracene
	Mercury			Dibenzofuran
	Nickel			Fluoranthene
	Selenium			Fluorene
	Silver			Naphthalene
	Vanadium			Phenanthrene
	Zinc			Pyrene
				2-Methylnaphthalene

Source: GRI, 1987. "Management of Manufactured Gas Plant Sites, Volume I"